

A STUDY OF FACILITIES AND EQUIPMENT AVAILABLE TO
GENERAL BIOLOGY TEACHERS IN SELECTED PUBLIC
SENIOR HIGH SCHOOLS OF KANSAS

by

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INTRODUCTION

Secondary school science teaching has undergone changes in recent years. Today more emphasis is placed on a detailed study of fewer topics, whereas formerly the major emphasis was placed on surveying the entire field of study. According to Martin, this trend has permitted a more flexible program that has been determined partly by the students.¹ Such a change of emphasis requires changes in the facilities and equipment provided for high school science. More portable equipment and furniture is needed to replace heavy, stationary facilities that were previously used.² As a result of this important change in approach to high school science teaching, numerous efforts have been made to establish criteria for building, equipping, and furnishing science classrooms and laboratories in the public schools of the United States. The criteria established in these studies have then been employed in surveys of existing school plants aimed at determining how well present conditions meet the established criteria.

The Problem

The purpose of this study was (1) to compare the facilities and equipment available in general biology rooms of selected Kansas secondary schools with some established criteria for general biology provisions; (2) to compare the facilities and equipment available in schools of different

¹W. Edgar Martin, "Planning Facilities for High School Biological Sciences," American School Board Journal, 145:20-24, July, 1962.

²Mathematics and Science Education in U.S. Public Schools, A Report of a Conference Held in Cooperation with the United States Department of Health, Education, and Welfare, Circular 533 (Washington: Government Printing Office, 1958), pp. 16-17.

sizes in Kansas; (3) to discover the teachers' opinions of the adequacy of the facilities and equipment available to them.

Importance of the Study

Koelsche's seven-State survey (1958-59) of high schools offering at least one science course showed that 96.5 per cent offered biology.³ Martin found biology courses to be "...now offered in more secondary schools and enrolling more pupils than any other science course," and that "for many pupils it is the only organized science course which they will complete during their years of formal education."⁴ This would indicate that biology should be taught using the best possible methods and equipment available, and any beneficial changes which can be made should be seriously considered.

Along with the emphasis in science education Martin noted a trend indicating a departure from the idea that "understanding of basic principles and methods of biology (was) necessary for college-bound pupils only."⁵ Concurrently, he reported increasing emphasis on the concept that such understanding of basic principles was "...a necessary component of general education for all pupils,"⁶ regardless of their future work. A change in philosophy such as this would demand new methods, equipment, and facilities for the teaching of high school biology.

Increasing interest has been shown in Kansas in upgrading school

³Charles L. Koelsche, "Today's Facilities and Equipment," The Nation's Schools, 65:107-110, February, 1960.

⁴Martin, op. cit., p. 21.

⁵Ibid.

⁶Ibid.

quality and in reorganizing the smaller schools into more efficient and effective units. As these new schools are built, efforts will be made to improve the present facilities. The objective of upgrading facilities and equipment in general biology classrooms and laboratories should be twofold: to give depth and breadth to the general education of all students, and to interest more of them in continuing with the study of science as preparation for careers. In order for such improvements to be made, the status of the existing facilities and equipment will need to be known. It is hoped that this study will contribute information concerning some of the general biology equipment and facilities existing in public high schools of Kansas today.

Definition of Terms

Facilities. For the purposes of this report, the term "facilities" will be used to refer to those features of the laboratory or classroom which are not easily moved about or are "built-in" in nature. Facilities include electricity and other utilities, windows, storage arrangements, immovable furniture, and other structural features of the room.

Equipment. The term "equipment" will be used in reference to more movable and less permanent features than the facilities discussed above. This term would include most laboratory instruments, semipermanent provisions for caring for living things, portable audio-visual materials, and apparatus of a similar nature.

Directory. This term will be used to refer to The Kansas Educational Directory for 1961-62.

REVIEW OF THE LITERATURE

Criteria used in this study were developed from selected literature and research and were chosen on the basis of one or more of the following:

- (1) frequency of mention
- (2) desirability as emphasized in the selected literature and research
- (3) feasibility of application to the State of Kansas as discerned by the writer of this report.

Recommendations concerning school facilities and equipment are frequently made by the State Legislatures. According to Martin,

Thirty-nine States have official published codes or guides which contain requirements, recommendations, or suggestions for the types of facilities and equipment which should be provided in new buildings.⁷

The remaining nine have no such official codes or guides. Kansas is one of the States having no official code, as is indicated by the following excerpt from a letter of G. W. Reida (Director of School Facilities Services, State Department of Public Instruction of Kansas, 1958):

...the State of Kansas does not have any special school building codes relating to school furniture and equipment. Our State Legislature has passed a law specifying that the State of Kansas shall use the National standards and school building codes in designing and erecting school buildings in the State of Kansas. Our State Legislature has never taken any action regarding any codes for furniture and equipment for science and mathematics, either on the elementary or the secondary levels.⁸

⁷W. Edgar Martin, Facilities and Equipment for Science and Mathematics, United States Department of Health, Education, and Welfare, Misc. No. 34 (Washington: Government Printing Office, 1960), p. 3.

⁸Ibid., p. 27.

Although Kansas itself has made no official recommendations concerning science facilities and equipment, the codes of other States were useful in evaluating the existing situation in Kansas schools.

Location of the biology room. Location of biology rooms in a science suite or separate science building was recommended by all authorities who discussed the subject. Martin et al. and Munch and Pelton stated that the science rooms should be placed near one another to facilitate the sharing of equipment and materials.⁹ Martin found that eleven States recommended "Adjacency of science facilities to one another, grouping of these facilities for easy communication between and among them, and joint usage of storage rooms..."¹⁰

Several authorities have made recommendations concerning the proximity of the biology room to other non-science rooms. Munch and Pelton recommended that the biology room be located near the home economics room and the audio-visual center.¹¹ In addition, according to Johnson, the biology room should be near the rooms used for teaching crafts, industrial arts, and vocational subjects.¹² Martin found that thirteen States recommended the location of science facilities near the rooms mentioned previously and also near the library and mathematics rooms. Such location

⁹W. Edgar Martin et al., "Facilities, Equipment and Instructional Materials for the Science Program," The Fifty-Ninth Yearbook of the National Society for the Study of Education, Part 1, 1960, pp. 229-257; Theodore W. Munch and Warren J. Pelton, "High School Science Facilities," American School Board Journal, 126:55-57, January, 1963.

¹⁰Martin, op. cit., p. 96.

¹¹Munch and Pelton, loc. cit.

¹²Philip G. Johnson, Science Facilities for Secondary Schools, United States Office of Education, Misc. No. 17 (Washington: Government Printing Office, 1952).

of the biology room was recommended

...in order to facilitate joint usage of all of these facilities by pupils, particularly in making equipment for experiments and demonstrations, and in preparing science projects or displays which require reference materials or hand or machine tools not usually found in science rooms.¹³

The exposure of the biology room was given attention by several workers. Martin et al. recommended that the windows of the biology room face the south or east to permit optimum lighting for growing plants and for aquaria.¹⁴ Martin found that most of the eighteen States that made recommendations concerning science room exposure mentioned a "sunny or southern exposure" for biology classes.¹⁵ Johnson, however, reported some disagreement among teachers as to the proper exposure of biology rooms. Although the southern exposure was considered better for growing plants, a northern exposure was found more suitable for microscopic work. He found many teachers who were apparently satisfied with north and east or north and west exposures.¹⁶

A study by Stapleford of recently-renovated or new Kansas high school science facilities showed that the percentages of science rooms having various exposures were: northern, 23; southern, 38.5; eastern, 38.5; and western, 7.7.¹⁷

It was generally agreed by those who mentioned it that biology rooms should be located so that the class members could leave and re-enter the

¹³Martin, op. cit.

¹⁴Martin et al., loc. cit.

¹⁵Martin, op. cit.

¹⁶Johnson, op. cit.

¹⁷Robert Stapleford, "A Study of Contemporary Science Rooms and Laboratories in Kansas High Schools" (unpublished Master's thesis, Kansas State Teachers College, Emporia, 1957).

room easily without disturbing other classes. Munch and Pelton suggested that in addition to having an easy exit the room should be located near a service road.¹⁸ According to Johnson, such location of the room would "...encourage teachers to arrange for field trips."¹⁹

General Criterion One suggested by the aforementioned sources is:

- (1) The biology room should be located near other science rooms.
- (2) It should be near shops.
- (3) It should be located near the home economics room.
- (4) It should be near the library.
- (5) It should have easy access to the out-of-doors.
- (6) Its windows should face to the south and/or east.

Classroom and laboratory arrangements. A trend in teaching philosophy away from distinct lecture and laboratory activities was noted by Martin.²⁰ Trends in classroom and laboratory arrangement observed by other investigators have indicated that such a change in philosophy has been occurring. In his seven-State survey, Koelsche found increasing numbers of schools which used multi-purpose laboratory-lecture rooms and few that used separate lecture and laboratory rooms.²¹ Obourn et al. reported that 69.6 per cent of all biology teachers contacted were teaching in combination lecture-laboratory rooms while 11.1 per cent used separate lecture

¹⁸Munch and Pelton, loc. cit. ¹⁹Johnson, op. cit., p. 6.

²⁰W. Edgar Martin, "Planning Facilities for High School Biological Sciences," American School Board Journal, 145:20-24, July, 1962.

²¹Charles L. Koelsche, "Today's Facilities and Equipment," The Nation's Schools, 65:107-110, February, 1960.

and laboratory rooms.²² Stapleford found that two of the thirteen schools in his study used separate lecture and laboratory rooms.²³

Obourn et al. reported that combination lecture-laboratory rooms for two sciences and multipurpose lecture-laboratory rooms for all sciences were most prevalent in United States public schools. Of the smallest schools, enrolling less than one hundred students, 7.5 per cent had combination rooms for one science, 24.5 per cent had rooms for two sciences, and 34.9 per cent used multipurpose rooms for all sciences. The percentages of schools with five hundred or more students which had such rooms were 31.3, 30.0, and 8.8, respectively.²⁴ Thus, because of the larger number of classes which they offered in each subject, the larger schools had more rooms for one or two sciences only. Koelsche also found this to be true.²⁵

The study by Obourn et al. found 19.2 per cent of the biology teachers using primarily non-science classrooms, with 25.5 per cent of the teachers in the smallest schools and 16.9 per cent of those in larger schools using that type of room.²⁶ In his survey, Koelsche found that about 20 per cent of the rooms used for science were non-science class-

²² Ellsworth S. Obourn et al., Science and Mathematics in Public High Schools, Facilities and Equipment, United States Department of the Interior, Bulletin No. 6

²³ "Science Rooms and Laboratories in Kansas High Schools" (unpublished Master's thesis, Kansas State Teachers College, Emporia, 1957).

²⁴ Obourn et al., op. cit.

²⁵ Koelsche, loc. cit.

²⁶ Obourn et al., op. cit.

rooms.²⁷

Where the arrangement of classroom furniture was concerned, Martin recommended maximum flexibility to allow for discussions and other group and individual activities. He suggested that a perimeter or island arrangement of furniture would best achieve this flexibility.²⁸

General Criterion Two, established from the above literature, is as follows:

- (1) Combination classroom-laboratory rooms appear advantageous over separate classrooms and laboratories.
- (2) The rooms used for biology should have been built for use by science classes.
- (3) An island or perimeter arrangement of furniture provides maximum flexibility in classroom and laboratory activities.

Storage facilities. In his article, Johnson pointed out that ...The facts show that effective and vital science teaching requires much apparatus, equipment, materials, and supplies. These must be near at hand in order to be available for teaching and learning activities. Convenient and accessible storage is the only answer.²⁹

Martin et al. recommended that dust-proof cases be provided for microscopes and other optical equipment and also that a refrigerator was necessary for storage of the perishable materials often used in biology

²⁷Koelsche, loc. cit.

²⁸W. Edgar Martin, "Planning Facilities for High School Biological Sciences," American School Board Journal, 145:20-24, July, 1962.

²⁹Philip G. Johnson, Science Facilities for Secondary Schools, United States Office of Education, Misc. No. 17 (Washington: Government Printing Office, 1952), P. 7.

classes.³⁰ Johnson noted that provisions should be made for storing corrosive chemicals away from corrodible equipment.³¹ Martin found that ten States recommended some storage facilities which locked and that five of these recommended locked storage for dangerous chemicals and delicate instruments.³² Martin repeated this recommendation in a later article.³³

Stapleford reported that of the thirteen Kansas high schools he studied 46 per cent stored science materials 'primarily in closed cabinets, cupboards, or drawers; 15.4 per cent stored most of their equipment on open shelves; and 38.5 per cent used both open and closed storage space. He also found that 69.2 per cent of the schools had some storage facilities which locked.³⁴

Martin et al. recommended that storage areas be present in at least two parts of the room to help prevent congestion.³⁵ According to Munch and Pelton, cabinets and drawers should be located with open spaces in front of them to permit orderly, uncrowded work.³⁶

³⁰W. Edgar Martin et al., "Facilities, Equipment and Instructional Materials for the Science Program," The Fifty-Ninth Yearbook of the National Society for the Study of Education, Part 1, 1960, pp. 229-257.

³¹Johnson, op. cit.

³²W. Edgar Martin, Facilities and Equipment for Science and Mathematics, United States Department of Health, Education, and Welfare, Misc. No. 34 (Washington: Government Printing Office, 1960).

³³W. Edgar Martin, "Planning Facilities for High School Biological Sciences," The American School Board Journal, 145:20-24, July, 1962.

³⁴Stapleford, op. cit.

³⁵Martin et al., loc. cit.

³⁶Theodore W. Munch and Warren J. Pelton, "High School Science Facilities," American School Board Journal, 126:55-57, January, 1953.

General Criterion Three, taken from the above authorities, recommends:

- (1) Some locked storage should be provided in the biology room.
- (2) Safe storage for dangerous chemicals should be provided.
- (3) Dustproof storage for optical equipment should be available.
- (4) A refrigerator should be provided.

Provisions for display. As was pointed out by Johnson, wide, open shelves may be used for display, but closed cases are more suitable, since they allow the display to remain undisturbed.³⁷ Munch and Pelton recommended a glassed-in, locked display area within the biology classroom and a display case in the hall outside of the room.³⁸ Johnson indicated that display outside of the classroom was desirable but not necessary and that such a display case should be provided with special lighting, electrical outlets, gas, and water.³⁹

In a survey of 1207 United States public high schools Obourn et al. found that about 40 per cent of the schools had display cases for science. The percentages of the schools of various sizes which had such display facilities varied from 21.7 per cent for schools with enrollments of less than one hundred to 48.7 per cent for schools with five hundred or more students.⁴⁰ Stapleford found that 30.8 per cent of the new Kansas science

³⁷Johnson, op. cit.

³⁸Munch and Pelton, loc. cit.

³⁹Johnson, op. cit.

⁴⁰Ellsworth S. Obourn et al., Science and Mathematics in Public High Schools 1958. Part 1. General Facilities and Equipment, United States Department of Health, Education, and Welfare, Bulletin No. 6 (Washington: Government Printing Office, 1960).

facilities included display cases outside of the science area.⁴¹

Tackboards as a display medium were discussed. Munch and Pelton stated that tackboards should be of ample size and located so that congestion is minimized.⁴² Byerley set fifteen square feet as the minimum area for adequate tackboard space.⁴³

From the above information, General Criterion Four recommends:

- (1) The biology classroom should contain a glassed-in display case.
- (2) The display facilities should lock.
- (3) There should be adequate tackboard and chalkboard space.

Special areas in the room. Areas which are present in a good biology room but which are not needed in classrooms for many other subjects were discussed by several authorities.

Munch and Pelton advised that a special area or room for the preparation of laboratory and demonstration materials be included.⁴⁴ Obourn et al. found that preparation rooms were included in 23.5 per cent of all schools studied. Only 7.2 per cent of the smallest schools provided such areas, while 31.2 per cent of the schools with five hundred or more students provided them.⁴⁵

Johnson, Martin et al., and Munch and Pelton recommended that project areas where long-term projects could be left undisturbed be in-

⁴¹Stapleford, op. cit.

⁴²Munch and Pelton, loc. cit.

⁴³J. Roy Byerley, "Planning and Equipping the Science Laboratory," American School Board Journal, 98:59-62, January, 1939.

⁴⁴Munch and Pelton, loc. cit. ⁴⁵Obourn et al., op. cit.

cluded in the biology room.⁴⁶ Such areas were found by Obourn et al. in only 8.1 per cent of all schools studied.⁴⁷

An office or conference area for the teacher with visual control of the class was recommended by Martin et al. and Johnson.⁴⁸ According to Johnson, such an area should have independent access to a corridor and the classroom.⁴⁹ Stapleford reported that 38.5 per cent of the recently-built Kansas science facilities provided offices for teachers, while 77 per cent had spaces considered useful for private conferences.⁵⁰

General Criterion Five recommends:

- (1) A preparation area for demonstrations and laboratories should be present in the biology room.
- (2) There should be an area present where long-term projects may be kept.
- (3) A conference area or office should be available for use by the biology teacher.

Utilities. Johnson has made several recommendations regarding the utilities or services which should be present in a well-equipped biology laboratory. According to his report, "Electrical services must be provided in proper form at convenient locations," and dual 110 volt a.c. out-

⁴⁶Johnson, op. cit.; W. Edgar Martin et al., "Facilities, Equipment and Instructional Materials for the Science Program," The Fifty-Ninth Yearbook of the National Society for the Study of Education, Part 1, 1960, pp. 229-257; and Munch and Pelton, loc. cit.

⁴⁷Obourn et al., op. cit.

⁴⁸Johnson, op. cit.; Martin et al., loc. cit.

⁴⁹Johnson, op. cit.

⁵⁰Stapleford, op. cit.

lets should be provided at each work station.⁵¹

Running water was considered necessary, with hot as well as cold water available in certain areas of the room for cleaning equipment. Stapleford found that 53.8 per cent of the new science facilities in Kansas were supplied with hot and cold running water.⁵²

Natural gas outlets were recommended, but liquefied gas in steel cylinders was considered a good substitute where natural gas was unavailable. Use of alcohol lamps or blowtorches for heating was discouraged.

The necessity of removing odors and fumes was discussed, but fume hoods were not considered essential for the biology room.

According to Obourn et al., 94.1 per cent of all high school science rooms studied were supplied with electrical outlets; 82.4 per cent of all science rooms had gas outlets available; and nearly 90 per cent reported that running water was provided.⁵³

General Criterion Six is:

- (1) Electrical outlets (110 volts a.c.) should be located conveniently and at each work station.
- (2) Either liquefied gas or natural gas should be provided.
- (3) Hot and cold running water should be available.

Demonstration equipment. It was agreed by all authorities consulted that a demonstration desk of some type should be present in the biology room. Byerley recommended that such a desk be equipped with a sink,

⁵¹ Johnson, op. cit., p. 7.

⁵² Stapleford, op. cit.

⁵³ Obourn et al., op. cit.

running water, and gas and electrical outlets.⁵⁴ In his study, Martin found that

Twenty States recommend that a demonstration desk of some type be provided in each room where science is taught; nineteen of these States recommend a regular fixed demonstration desk or table equipped completely with services, or utilities of gas, electricity, and water. Two States recommend a movable demonstration table, cart, or desk equipped with these services.⁵⁵

Johnson recommended the use of a movable demonstration desk where the room was a multipurpose one and demonstrations could not be set up in advance.⁵⁶ Obourn et al. found that 77.7 per cent of all schools studied included demonstration tables as a part of their science facilities and that 11.5 per cent used movable demonstration tables. However, only 1.2 per cent of the smallest schools used such tables, although these schools were most likely to have multipurpose science rooms.⁵⁷ In his study of new Kansas science facilities, Stapleford found that 100 per cent of the schools used demonstration tables and that 46 per cent had movable desks or laboratory carts.⁵⁸

Of the public high school science teachers contacted by Obourn et al., 51.3 per cent felt that their demonstration equipment was adequate

⁵⁴Byerley, loc. cit.

⁵⁵W. Edgar Martin, Facilities and Equipment for Science and Mathematics, United States Department of Health, Education, and Welfare, Misc. No. 34 (Washington: Government Printing Office, 1960), p. 114.

⁵⁶Philip G. Johnson, Science Facilities for Secondary Schools, United States Office of Education, Misc. No. 17 (Washington: Government Printing Office, 1952).

⁵⁷Obourn et al., op. cit.

⁵⁸Stapleford, op. cit.

and 68.6 per cent felt a need for new, modern equipment.⁵⁹

Johnson and Martin et al. recommended highly the use of a special spotlight arrangement above the demonstration table.⁶⁰ Stapleford found, however, that only one of the thirteen schools in his study provided such special lighting for demonstrations.⁶¹

General Criterion Seven includes:

- (1) A demonstration desk, either stationary or movable, should be provided.
- (2) Gas, running water, and electricity should be available at the demonstration desk.
- (3) Special lighting should be arranged at or near the demonstration desk.

Audio-visual aids. Since the use of much available audio-visual equipment requires darkness, several writers have recommended darkening facilities for the biology room. Johnson indicated that such provisions be included in the room.⁶² Munch and Pelton added that darkening provisions should be easy to operate and allow for adequate ventilation while the room is dark.⁶³ Martin noted that sixteen States recommended provisions for darkening science rooms.⁶⁴ Obourn et al. found that about 65

⁵⁹Obourn et al., op. cit.

⁶⁰Johnson, op. cit.; Martin et al., loc. cit.

⁶¹Stapleford, op. cit. ⁶²Johnson, loc. cit.

⁶³Theodore W. Munch and Warren J. Pelton, "High School Science Facilities," American School Board Journal, 126:55-57, January, 1953.

⁶⁴W. Edgar Martin, Facilities and Equipment for Science and Mathe-

per cent of the public high schools of the United States had darkening provisions within the school rooms,⁶⁵ while the Kansas school study made by Stapleford revealed that about 46 per cent of the science rooms could be darkened.⁶⁶

Johnson recommended films, slides, recordings, radio presentations, television, microscopes, microprojectors, screens, projectors for films and slides, models, mock-ups, and tape recorders as necessary audio-visual equipment for use in biology classes.⁶⁷ In his study of new Kansas science facilities, Stapleford found that 100 per cent of the science rooms had access to 16 mm. motion picture projectors and slide-filmstrip projectors; 84.6 per cent had microprojectors; 53.8 per cent had opaque projectors; and one of the thirteen schools had an overhead projector.⁶⁸

General Criterion Eight for evaluating audio-visual equipment is:

- (1) Darkening provisions should be included within the biology room.
- (2) Audio-visual equipment provided should include a screen, motion picture projector, slide-filmstrip projector, and a microprojector.
- (3) Microscopes for student use should be present.

Tools and laboratory equipment. The presence of tools in the biology

matics, United States Department of Health, Education, and Welfare, Misc. No. 34 (Washington: Government Printing Office, 1960).

⁶⁵Obourn et al., op. cit.

⁶⁶Stapleford, op. cit.

⁶⁷Johnson, op. cit.

⁶⁸Stapleford, op. cit.

room was recommended by several authorities. Typical was the statement by Byerley that a workbench should be provided with a good set of tools for working with wood or metal.⁶⁹ Tools were considered necessary not only for the building of improvised equipment and projects but also for repairing the equipment already in use. It was generally felt that more tools were needed in biology rooms. In schools of the seven States which he studied, Koelsche found very few science departments which had adequate tool supplies.⁷⁰

The use of improvised equipment for biology was considered by Allen to be beneficial unless this type of equipment was the only kind available.⁷¹ Koelsche reported that 57.7 per cent of the schools he surveyed were using improvised equipment in science instruction.⁷² Obourn et al. found that six out of ten biology teachers in high schools of the United States used improvised equipment frequently.⁷³

Opinions were obtained by Obourn et al. from public high school science teachers about the laboratory equipment supplied to them. These investigators found that 37.7 per cent of the teachers felt the student laboratory equipment was adequate; 63.5 per cent reported an adequate supply of glassware; 72.2 per cent felt that their supplies of general equip-

⁶⁹J. Roy Byerley, "Planning and Equipping the Science Laboratory," American School Board Journal, 98:59-62, January, 1939.

⁷⁰Charles L. Koelsche, "Today's Facilities and Equipment," The Nation's Schools, 65:107-110, February, 1960.

⁷¹Otis W. Allen, "Tool Up the Schools for Science," American School and University, 1959, pp. 37-40.

⁷²Koelsche, loc. cit.

⁷³Obourn et al., op. cit.

ment were adequate. In all of these cases, the percentage of smaller schools with adequate equipment was lower than that for larger schools. A large amount of broken equipment which could be used if repaired was reported by 11.4 per cent of the schools.⁷⁴

General Criterion Nine concerning equipment for biology is:

- (1) A good set of tools for working with wood or metal should be available for use by biology students.
- (2) Some improvised equipment should be used, but not to the exclusion of more expensive and sophisticated types.

Provisions for living things. Martin reported a trend in biology teaching toward the increased use of living materials rather than preserved specimens alone.⁷⁵ In keeping with this observed trend, Johnson stated that biology teachers needed to have supplies and facilities for collecting and using living materials.⁷⁶ Byerley recommended that a well-stocked aquarium, germinating bed, and animal breeding cages be included in the biology room.⁷⁷ Terraria were recommended by Martin.⁷⁸ Johnson, Martin, Martin et al., and Munch and Pelton suggested that plant and animal growing areas be provided with temperature, light, and humidity controls, and that they be located preferably in a room separate from the classroom.⁷⁹

⁷⁴Ibid.

⁷⁵W. Edgar Martin, "Planning Facilities for High School Biological Sciences," American School Board Journal, 145:20-24, July, 1962.

⁷⁶Johnson, op. cit.

⁷⁷Byerley, loc. cit.

⁷⁸Martin, loc. cit.

⁷⁹Johnson, op. cit.; Martin, loc. cit.; W. Edgar Martin et al.,

According to Martin, "Twenty-one States make one or more recommendations regarding the provision of aquaria, terraria, growing tables, and other equipment in science rooms for growing or taking care of living plants and animals."⁸⁰ He found that seventeen States recommended aquaria, and that of these two recommended aquarium tanks for biology. Eight States recommended terraria and eleven advised the use of growing tables or bins. In addition, these provisions for living things were recommended: "...greenhouse or growing room, arboretum, animal pens or cages,...soil bins, and potting areas..."⁸¹

Besides provisions within the school for plants and animals, Martin recommended the availability of growing plots, gardens, parks, and forests for use by biology students.

In his study of new Kansas science facilities and equipment, Stapleford found that two of the thirteen schools had areas for the display and care of plants. One of these schools had a special room for that purpose. He found that 30.8 per cent of the schools had animal cages; 46 per cent had terraria; and ten of the schools had large aquaria with drains while the other three had smaller, portable aquaria.⁸² Obourn et

"Facilities, Equipment and Instructional Materials for the Science Program," The Fifty-Ninth Yearbook of the National Society for the Study of Education, Part I, 1960, pp. 229-257; and Theodore W. Munch and Warren J. Felton, "High School Science Facilities," American School Board Journal, 126:55-57, January, 1953.

⁸⁰W. Edgar Martin, Facilities and Equipment for Science and Mathematics, United States Department of Health, Education, and Welfare, Misc. No. 34 (Washington: Government Printing Office, 1960), p. 115.

⁸¹Ibid., p. 119.

⁸²Stapleford, op. cit.

al. found that 3.4 per cent of the schools which were studied reported animal rooms; 3.5 per cent had garden plots, 5.1 per cent had separate greenhouses, 3.4 per cent had nature trails, and 6.4 per cent had plant growing rooms.⁸³

General Criterion Ten includes:

- (1) An aquarium, either portable or tank type, should be provided for use by general biology classes.
- (2) A germinating bed should be present.
- (3) There should be cages for animals.
- (4) A terrarium should be available.

Provisions for safety. In order for a biology room to be considered adequate it must have equipment which provides for the safety of those using the room. Johnson indicated that safety measures should be taken, particularly with respect to fire hazards.⁸⁴ Byerley recommended that each science room be supplied with a first aid kit or cabinet, a laboratory emergency chart, a woolen blanket, and a fire extinguisher.⁸⁵

In his study of Kansas schools, Stapleford found that 46.5 per cent of the science areas had first aid equipment; 53.8 per cent had fire extinguishers within the rooms; and 30.8 per cent of the rooms were located

⁸³Ellsworth S. Obourn et al., Science and Mathematics in Public High Schools 1958. Part 1. General Facilities and Equipment, United States Department of Health, Education, and Welfare, Bulletin No. 6 (Washington: Government Printing Office, 1960).

⁸⁴Philip G. Johnson, Science Facilities for Secondary Schools, United States Office of Education, Misc. No. 17 (Washington: Government Printing Office, 1952).

⁸⁵Byerley, loc. cit.

near fire extinguishers in the hall. This study also showed that 38.5 per cent of the teachers gave fire fighting instructions to their students.⁸⁶

General Criterion Eleven recommends:

- (1) A first aid kit should be supplied to the biology room.
- (2) The biology room should have a laboratory first aid chart.
- (3) There should be a fire extinguisher within the room or an extinguisher or hose in a nearby hall.

School size related to equipment and facilities. The findings of the authorities consulted in this investigation indicated that the larger schools were usually better equipped for teaching biology than were the smaller schools. Koelsche found that the facilities and equipment tended to be better in the larger schools.⁸⁷ According to Obourn et al., "Larger schools as a group had a wider variety of facilities than did small schools."⁸⁸

PROCEDURES USED

The data for this study were obtained by means of a questionnaire sent to one hundred Kansas public high schools during April and May of 1963. The names and addresses of these schools were obtained from the Directory.

⁸⁶Stapleford, op. cit.

⁸⁷Charles L. Koelsche, "Today's Facilities and Equipment," The Nation's Schools, 65:107-110, February, 1960.

⁸⁸Obourn et al., op. cit., p. 17.

For this study it was desirable to obtain information from schools that represented all of the school enrollment sizes found in Kansas and in approximately the same proportion in which these sizes appeared. In this way it was considered possible to get overall figures which would be fairly representative of the situation in Kansas. However, it was found that nearly half of Kansas public high schools had enrollments of less than one hundred, and that at least 20 per cent had enrollments of 100 to 199. In order to assure responses from schools of all sizes in Kansas, only 25 per cent of the questionnaires were sent to schools with less than one hundred students enrolled and the percentages sent to the larger schools were increased accordingly (see Appendix A).

The Kansas public schools listed in the Directory were divided into groups according to size, based on enrollment figures for grades nine through twelve, and a certain number from each group were selected. Except in the largest cities operating several high schools, the figures for grades nine through twelve given in the Directory were the same as the high school enrollments in these grades. For the large cities, the high school enrollment was assumed to be one thousand or more.

The items included in the questionnaire were based on the criteria which had been developed. Other items mentioned by the sources studied were also included at the discretion of the writer. The teachers were asked to evaluate the different facilities and equipment in terms of their own methods of teaching.

A copy of the questionnaire sent to the various schools is included in Appendix B. This questionnaire and a letter (Appendix C) were sent

to the administrator of each school. This administrator was either the school superintendent or principal, whichever official was listed in the Directory. The letter explained the purpose and importance of the questionnaire and requested that the administrator ask his general biology teacher to complete the form and return it in the enclosed stamped envelope. The questionnaires were given code numbers for use in analyzing the information and were mailed, along with the letters, to all one hundred schools selected. A follow-up letter (see Appendix D) was later sent, along with another copy of the questionnaire and a stamped envelope, to the schools which had not responded. By the end of the school year ninety-two of the questionnaires had been returned.

The questionnaires were divided into groups according to the size school they represented, and the number of positive responses for Parts I through IV were tabulated. In Part V (class load) the various answers given were recorded and the numbers of teachers giving the same responses were tabulated. The numbers of teachers feeling that a given classroom provision was excellent, adequate, or unsatisfactory were tabulated in Part VI (teacher evaluation). For each possible response provided for in the questionnaire, the total number of responses in each size group as well as the percentage of the group making the response was calculated. The total number of responses to each item was calculated for the entire group, along with the per cent of the entire group making the response. In this way per cent response on a given item for one of the size groups could be compared with the per cent response either for all of the participating schools or for another size group.

Additional comments and recommendations volunteered by the teachers were noted according to the size of the school and for the group as a whole and will be discussed where appropriate.

ANALYSIS OF RESULTS

Location of the biology room. Table I shows the locations of biology rooms reported by the schools studied. Over half of these schools indicated that the biology room was located near other science rooms and that there was easy access to the out-of-doors from the room. With respect to these two items, general biology classrooms of Kansas met General Criterion One. About 40 per cent of the rooms were located near home economics rooms, and about 30 per cent near the library, and less than 10 per cent were near shops. In these respects, Kansas biology rooms did not meet the established criteria.

In the larger schools there were more separate science wings or buildings and the biology rooms were more often located near other science rooms than in the smaller schools. The larger schools were also more likely to have home economics rooms located near the biology room than were the smaller schools. In the smaller schools, however, more biology rooms were located near the shops and library than in the larger schools.

The various exposures of the biology rooms studied are shown in Table II. Nearly 70 per cent of the rooms had either a southern or eastern exposure, so in this respect the schools met the established criteria for location of the room. About one-fourth had windows facing west. Other responses to this item included a room with no windows and rooms with sky

TABLE I

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS REPORTING
VARIOUS LOCATIONS OF GENERAL BIOLOGY ROOMS

Enrollment	Number of Respon- dents	Locations Reported							
		Separate Science Wing or Building	Near Science Rooms	Near Other Rooms	Near Shops	Near Home Ec. Rooms	Near Math Rooms	Near Library	Easy Access to Out- of-Doors
		No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %
Less than 100	20	2 10	5 25		3 15	3 15	10 50	13 65	13 65
100 - 299	32	3 9.4	14 43.7		3 9.4	4 12.5	11 34.4	11 34.4	15 46.8
300 - 999	30	14 46.7	23 76.7		3 10	7 23.3	5 16.6	11 36.6	16 53.4
1,000 or more	10	3 30	7 70		0 0	5 50	2 20	2 20	6 60
Total	92	14 15.2	49 53.3		9 9.8	19 20.3	28 30.2	37 40.2	51 55.5

TABLE II
NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS
REPORTING VARIOUS EXPOSURES OF THE
GENERAL BIOLOGY CLASSROOM

Enrollment	Number of Respon- dents	Exposures Reported				
		North $\frac{\text{No.}}{\%}$	East $\frac{\text{No.}}{\%}$	South $\frac{\text{No.}}{\%}$	West $\frac{\text{No.}}{\%}$	Other $\frac{\text{No.}}{\%}$
Less than 100	20	2 10	4 20	13 65	5 25	0 0
100 - 299	32	9 28.1	8 25	8 25	11 34.4	1 3.1
300 - 999	30	7 23.3	9 30	16 53.4	6 20	2 6.7
1,000 or more	10	3 30	1 10	5 50	1 10	1 10
Total	92	21 22.8	22 23.9	42 45.6	23 25	4 4.4

lights.

Teacher evaluations of the room locations are shown in Fig. 1. Nearly three-fourths of all the teachers responding felt the location of their rooms was satisfactory. All of the teachers from the smallest schools who responded on this item felt that their rooms were satisfactorily located. Teachers from the largest schools reported excellent locations more often than did teachers from the other schools. Three teachers remarked that their rooms were not on the ground floor and that this was a handicap to them in their teaching; one teacher felt that the noise from the nearby shop rooms disturbed his classes.

Classroom and laboratory arrangements. The three types of classroom and laboratory arrangements reported by the schools in this study are shown in Table III.

The schools of Kansas appear to be following the trend toward classroom-laboratory combinations. Such rooms were reported by 82.5 per cent of the schools, and appeared about as frequently in the smallest as in the largest schools. Separate classrooms and laboratories were found in about 14 per cent of the schools. None of the largest schools reported rooms of this type. Classrooms not built for science were being used for general biology in 13 per cent of the schools. They were found more frequently in the smaller than in the larger schools.

The student furniture arrangements reported are shown in Table IV. Nearly 60 per cent of the schools reported tables in rows for laboratory work, and 44.5 per cent of the schools reported that students sat at the laboratory desks during classroom as well as laboratory activities.

FIGURE 1

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE LOCATIONS OF THE ROOMS
IN WHICH THEY WORKED

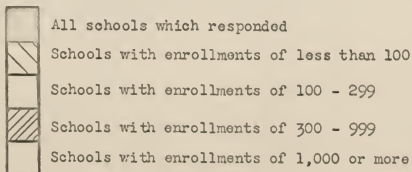
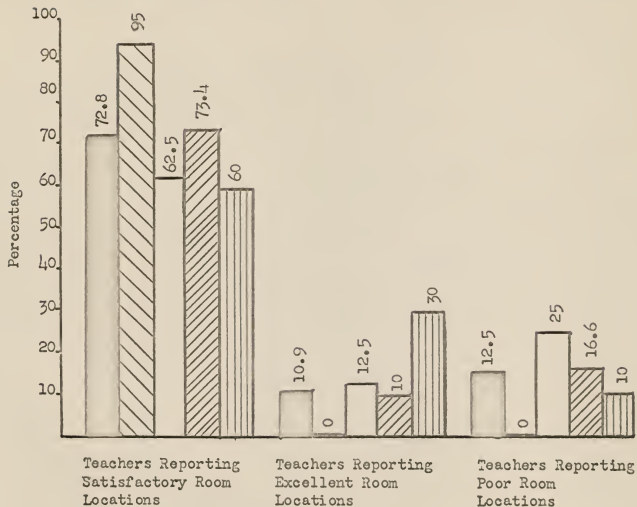


TABLE III
NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS
REPORTING VARIOUS CLASSROOM ARRANGEMENTS
FOR GENERAL BIOLOGY

Enrollment	Number of Respon- dents	Arrangements Reported					
		Combination Classroom- Laboratory		Separate Classroom and Lab.		Classroom Not Built for Science	
		No.	%	No.	%	No.	%
Less than 100	20	17	85	2	10	4	20
100 - 299	32	26	81.2	5	15.6	5	15.6
300 - 999	30	24	80	6	20	2	6.7
1,000 or more	10	9	90	0	0	1	10
Total	92	76	82.5	13	14.1	12	13

TABLE IV

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS
REPORTING VARIOUS STUDENT FURNITURE ARRANGEMENTS
FOR GENERAL BIOLOGY CLASSES

Enrollment	Number of Respon- dents	Furniture Arrangements Reported									
		Perimeter Arrangement of Laboratory Desks		Island Arrangement of Laboratory Desks		Laboratory Desks are Tables in Rows		Students Sit at Lab. Desks for Classroom Activities as well as Laboratory		Other Student Furniture Arrangements	
		No.	%	No.	%	No.	%	No.	%	No.	%
Less than 100	20	9	45	1	5	7	35	4	20	2	10
100 - 299	32	7	21.8	9	28.1	17	53.2	11	34.4	0	0
300 - 999	30	5	16.6	2	6.7	23	76.7	19	63.4	1	3.3
1,000 or more	10	1	10	1	10	7	70	7	70	1	10
Total	92	22	23.9	13	14.1	54	58.7	41	44.5	4	4.4

Almost 24 per cent of the schools reported perimeter laboratory desk arrangements and 14.1 per cent reported island arrangements. From these results it appears that general biology classrooms fell short of the flexibility called for in General Criterion Two.

Perimeter desk arrangements were found increasingly in the smaller schools, while the largest schools tended to have tables in rows at which students sat for both classroom and laboratory activities. Other student furniture arrangements mentioned included classroom chairs only, with no provisions for laboratory work.

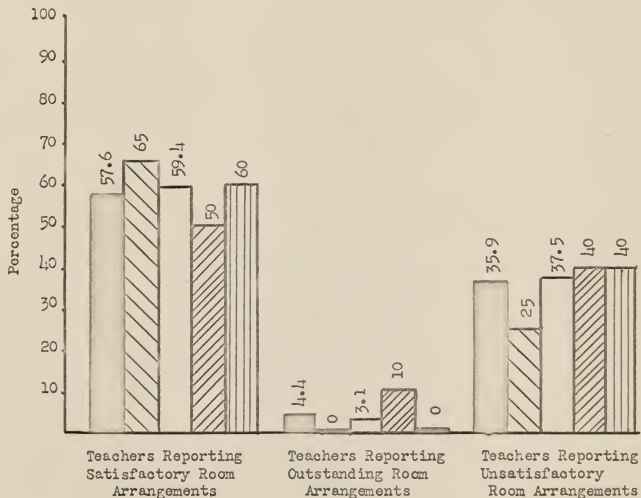
As is indicated in Fig. 2, over half of the teachers were satisfied with the classroom and laboratory arrangements of their rooms; however, about 36 per cent of all the teachers reported dissatisfaction with the arrangements.

Fig. 3 shows that only a little over half of the responding teachers felt that the furniture arrangements of their biology rooms were effective. Poor furniture arrangements were reported by 38 per cent of all the teachers. Generally, the teachers in the smallest schools were most satisfied with the furniture arrangements, while those in the largest schools were least satisfied. Poor furniture arrangements were reported by 60 per cent of the largest schools. Teachers specifically mentioned that some of the furniture arrangements caused crowding, made it difficult for the teacher to help the students, and forced some of the students to sit with their backs to the teacher. It was recommended by one teacher that workbenches be placed down the center of the room.

Storage facilities. Table V shows the storage facilities which

FIGURE 2

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE CLASSROOM AND LABORATORY
ARRANGEMENTS AVAILABLE



All schools which responded

Schools with enrollments of less than 100

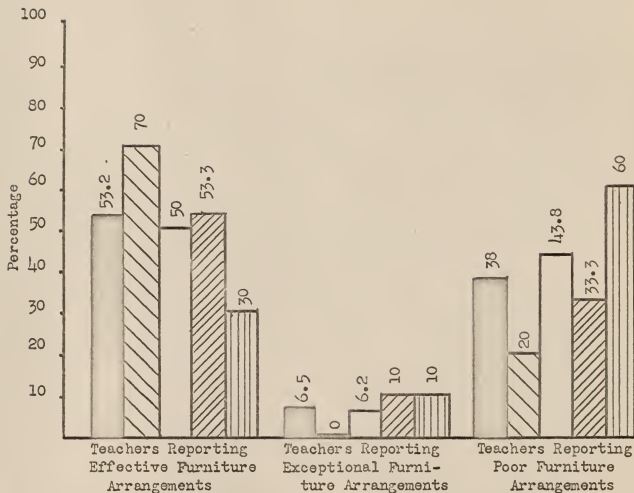
Schools with enrollments of 100 - 299

Schools with enrollments of 300 - 999

Schools with enrollments of 1,000 or more

FIGURE 3

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE FURNITURE ARRANGEMENTS
WITHIN THEIR CLASSROOMS*



*as to whether or not the furniture arrangement was conducive to orderly, uncluttered work.



All schools which responded

Schools with enrollments of less than 100

Schools with enrollments of 100 - 299

Schools with enrollments of 300 - 999

Schools with enrollments of 1,000 or more.

TABLE V
NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS
REPORTING VARIOUS STORAGE FACILITIES FOR
GENERAL BIOLOGY CLASSROOMS

Enrollment	Number of Respon- dents	Storage Facilities Reported							
		Open Shelves	Cupboards	Glassed-in Shelves	Drawers	Dust-proof Storage*	Special Storage**	No.	%
		No.	%	No.	%	No.	%	No.	%
Less than 100	20	3	15	10	50	15	75	5	25
100 - 299	32	16	50	15	46.8	23	71.8	18	56.3
300 - 999	30	11	36.7	23	71.9	16	52.3	11	36.7
1,000 or more	10	7	70	7	70	7	70	8	80
Total	92	37	40.3	55	59.8	61	66.4	42	45.6
								35	38

*For optical equipment.

**For dangerous chemicals.

TABLE V (continued)

Enrollment	Number of Respon- dents	Storage Facilities Reported					
		Some Facilities Which Lock	Individual Storage for Students	Storage for Use by Teacher	Refrigerator	Other	
		No. %	No. %	No. %	No. %	No. %	
Less than 100	20	17 85	6 30	11 55	1 5	0 0	
100 - 299	32	24 75	12 37.5	22 68.8	4 12.5	0 0	
300 - 999	30	19 63.4	7 23.3	20 66.7	5 16.6	2 6.7	
1,000 or more	10	10 100	4 40	8 80	7 70	1 10	
Total	92	70 76	29 31.6	61 66.4	17 18.5	3 3.3	

were reported by the schools in this study. Dust-proof storage for optical equipment was reported by 45.6 per cent of the schools. Refrigerators were available in only 18.5 per cent of the rooms. In these respects the biology rooms studied failed to meet General Criterion Three adequately. Locked storage was reported by 76 per cent of the schools. With regard to this item schools of Kansas appeared to meet General Criterion Three.

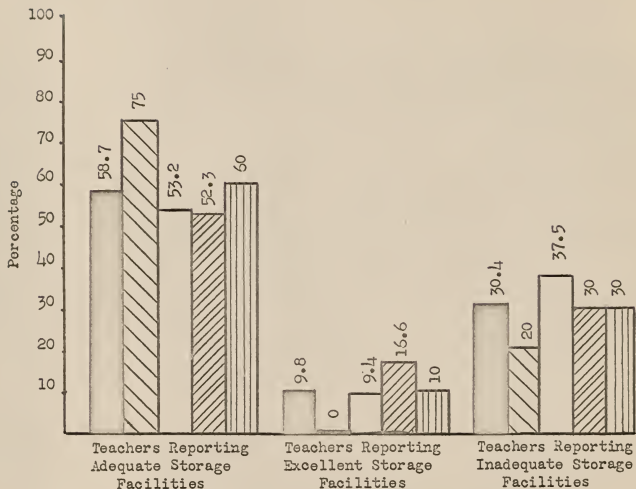
Dust-proof storage for optical equipment was found more in the larger schools than in the smaller ones, whereas the smaller schools appeared better provided with special storage for dangerous chemicals. Refrigerators were found to a much greater extent in the largest than in the smallest schools.

Drawers were the most frequently mentioned means of storage (66.4%); cupboards and glassed-in shelves were reported about equally (57.6% and 59.8%, respectively); open shelves appeared to be used least often, and to a greater extent by the largest than by the smallest schools. Storage for individual students was provided in 31.6 per cent of the schools; storage for the teacher was reported in 66.4 per cent of the schools and appeared more frequently in the larger than in the smaller schools.

Fig. 4 shows the evaluations by the teachers of their storage facilities. Nearly 70 per cent of all the teachers felt that their storage facilities were adequate or excellent. The teachers in the smallest schools appeared most satisfied with these facilities. Of the teachers who were dissatisfied with storage facilities, many reported

FIGURE 4

EVALUATIONS BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE STORAGE FACILITIES
AVAILABLE TO THEM



All schools which responded

Schools with enrollments less than 100

Schools with enrollments of 100 - 299

Schools with enrollments of 300 - 999

Schools with enrollments of 1,000 or more

that there was inadequate space available.

Provisions for display. Data concerning the availability of display facilities are shown on Table VI. It was found that nearly half of the schools responding provided glassed-in display cases within general biology rooms. In this respect the schools studied approached General Criterion Four but did not meet it. Only 14.1 per cent of the schools supplied glassed-in display cases outside of the biology room. Nearly 35 per cent of the schools reported locked display facilities. Here again the schools failed to meet General Criterion Four adequately. Adequate chalkboard space was reported by nearly three-fourths of the schools, whereas adequate tackboard space was reported by a little more than half of them. In this case the schools met General Criterion Four fairly well. The amount of space considered adequate may vary greatly from one teacher to another.

Except in the case of tackboards, the largest schools reported having considerably more display facilities than did the smaller schools. This trend was particularly noticeable where glassed-in display cases within the classroom were concerned.

Other provisions for display mentioned by the teachers included open display cases within the classroom, shelves, tables, pegboards, mammal and bird skin cases, and window shelves for aquaria.

The evaluations by the teachers of the display facilities available to them are shown in Fig. 5. Half of the teachers felt that their provisions for display were inadequate. Teachers in the largest schools were by far the most satisfied with the facilities available to them, while

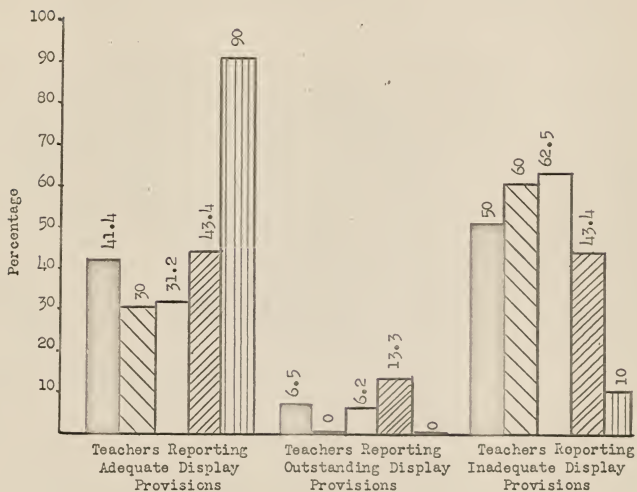
TABLE VI

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS REPORTING
VARIOUS DISPLAY PROVISIONS FOR
GENERAL BIOLOGY CLASSES

Enrollment	Number of Respon- dents	Display Provisions Reported											
		Classed-in Case Within Classroom		Classed-in Case Outside Classroom		Locked Display Cases		Adequate Chalkboards		Adequate Trackboards		Other	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less than 100	20	6	30	3	15	7	35	15	75	10	50	0	0
100 - 299	32	12	37.5	3	9.4	7	21.8	24	75	19	59.4	4	12.5
300 - 999	30	19	63.4	4	13.3	10	33.3	18	60	19	63.4	2	6.7
1,000 or more	10	8	80	3	30	8	80	9	90	6	60	0	0
Total	92	45	49	13	14.1	32	34.8	66	71.7	54	58.7	6	6.5

FIGURE 5

EVALUATIONS BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE PROVISIONS FOR DISPLAY
AVAILABLE TO THEM



All schools which responded

Schools with enrollments of less than 100

Schools with enrollments of 100 - 299

Schools with enrollments of 300 - 999

Schools with enrollments of 1,000 or more

those in schools of the two smallest size groups were least satisfied. Several teachers remarked that there were no provisions for display available to them.

Special areas in the room. Table VII shows the special areas within the biology classroom reported in this study. Preparation areas were available in 58.7 per cent of the rooms, and were found as frequently in the small schools as in the large ones. With respect to this provision, the schools studied met General Criterion Five.

Areas in which long-term projects could be pursued were reported by 29.4 per cent of the schools; offices or conference areas for teachers were reported by 16.3 per cent. In these two respects, then, Kansas high schools appeared to fall short of General Criterion Five.

Areas for maintenance and repair of equipment were reported in 23.9 per cent of the schools.

Utilities. Utilities reported by Kansas general biology teachers are shown in Table VIII. Natural gas was found to be available in 80.4 per cent of the schools and bottled gas in 15.2 per cent. Bottled gas was found to be used most in the smallest schools. Hot and cold running water was reported by 65.3 per cent of the schools, while cold water only was available in 31.6 per cent of the schools. Electrical outlets (110 volts a.c.) were reported by 90.2 per cent of the schools, and 78.4 per cent indicated that the outlets were conveniently located. These data indicate that Kansas high schools meet General Criterion Six.

Utilities for student work stations were not so well provided. Electrical outlets were reported available at student desks in 40.2 per

TABLE VII

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS REPORTING
SPECIAL AREAS WITHIN THE GENERAL BIOLOGY CLASSROOM

Enrollment	Number of Respon- dents	Special Areas Reported							
		Laboratory & Demonstration & Area		Area for Maintenance and Repair of Equipment		Area for Long-term Projects		Office or Conference Area for Teacher	
		No.	%	No.	%	No.	%	No.	%
Less than 100	20	12	60	3	15	6	30	1	5
100 - 299	32	20	62.5	10	31.3	10	31.3	7	21.8
300 - 999	30	16	53.4	6	20	9	30	6	20
1,000 or more	10	6	60	3	30	2	20	1	10
Total	92	54	58.7	22	23.9	27	29.4	15	16.3

TABLE VIII

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC SCHOOLS REPORTING VARIOUS
UTILITIES PRESENT IN GENERAL BIOLOGY ROOMS

Enrollment	Number of Respon- dents	Utilities Reported							
		Natural Gas	Bottled Gas	Fume Hood	Cold Water Only	Hot and Cold Water	a.c. Outlets	Convenient a.c. Outlets	
		No. %	No. %	No. %	No. %	No. %	No. %	No. %	
Less than 100	20	10 50	9 45	4 20	10 50	10 50	5 25	15 75	
100 - 299	32	27 84.4	4 12.5	11 34.4	12 37.5	19 59.4	7 21.8	25 78.1	
300 - 999	30	27 90	1 3.3	5 16.6	4 13.3	24 80	4 13.3	25 83.4	
1,000 or more	10	10 100	0 0	0 0	3 30	7 70	4 40	7 70	
Total	92	74 80.4	14 15.2	20 21.8	29 31.6	60 65.3	20 21.8	72 78.4	

TABLE VIII (continued)

Enrollment	Number of Respon- dents	Utilities Reported			
		Gas Outlets at Student Desks	Running Water at Student Desks	Electrical Outlets at Student Desks	Other
		No. %	No. %	No. %	No. %
Less than 100	20	7 35	7 35	7 35	0 0
100 - 299	32	17 53.2	14 43.8	15 46.8	1 3.1
300 - 999	30	11 36.6	8 26.6	13 43.4	1 3.3
1,000 or more	10	1 10	0 0	2 20	1 10
Total	92	36 39.2	29 31.6	37 40.2	3 3.3

cent of the schools; 39.2 per cent reported that gas outlets were available at the desks; running water was available at student desks in 31.6 per cent of the schools. Gas outlets and running water at student desks appeared somewhat more frequently in the smaller than in the larger schools. With respect to utilities for student use, Kansas schools appeared to fall short of General Criterion Six.

Fume hoods were reported in general biology rooms by 21.8 per cent of the schools; however none was reported by the largest schools.

Fig. 6 records the biology teachers' evaluations of the utilities provided for them. About 73 per cent of them felt that their utilities were adequate or excellent, whereas 25 per cent reported inadequate utilities. The teachers at smaller schools appeared most satisfied and those at the largest schools least satisfied with the utilities provided. Improvements suggested by the teachers included the installation of more utilities, more convenient arrangement of the utilities, and installation of garbage disposal units.

Demonstration equipment. The data concerning demonstration equipment available to Kansas general biology teachers are presented in Table IX. Fixed demonstration desks were reported by 90.3 per cent of the schools; 17.4 per cent reported a movable desk or cart. Running water was supplied at 87 per cent of the desks, gas outlets were present at 86 per cent of them, and 87 per cent were furnished with electrical outlets. Only 4.4 per cent of the schools reported special lighting arrangements for demonstrations. With the exception of the special lighting, these schools appeared to have met General Criterion Seven satisfactorily.

FIGURE 6

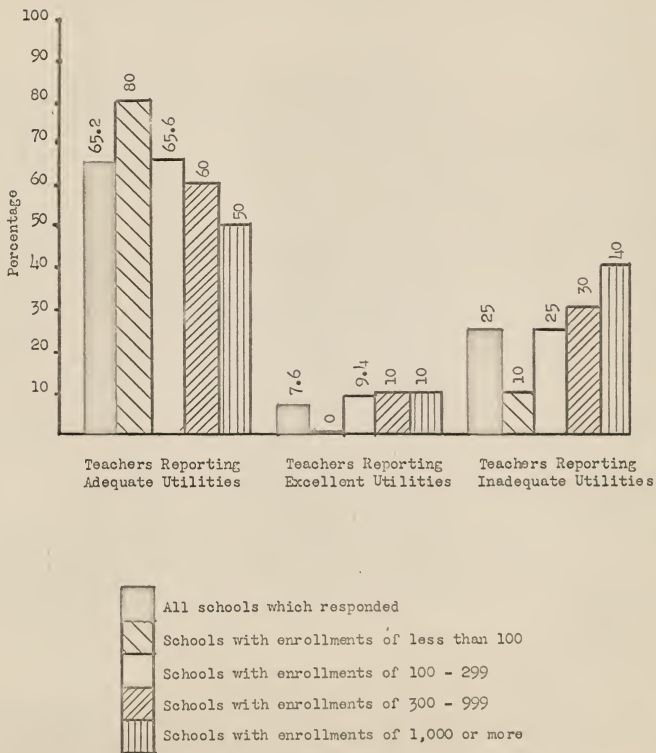
EVALUATIONS BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE UTILITIES AVAILABLE TO THEM

TABLE IX

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC SCHOOLS REPORTING VARIOUS
PROVISIONS FOR DEMONSTRATIONS WITHIN GENERAL BIOLOGY
CLASSROOMS

Enrollment	Number of Respon- dents	Demonstration Facilities and Equipment Reported									
		Fixed Desk	Movable Desk or Cart		Running Water		Utilities Present at Demonstration		Desk		Other
		No. %	No.	%	No.	%	Gas Outlet	Electrical Outlet	Special Lighting	No.	%
Less than 100	20	17 85	2	10	16	80	17 85	15 75	2 10	0	0
100 - 299	32	31 97	6	18.7	29	90.7	23 87.5	30 93.7	0 0	2 6.3	
300 - 999	30	26 86.7	7	23.3	27	90	25 83.4	26 86.7	2 6.7	1 3.3	
1,000 or more	10	9 90	1	10	8	80	9 90	9 90	0 0	1 10	
Total	92	83 90.3	16	17.4	80	87	79 86	80 87	4 4.4	4 4.4	

Other provisions for demonstrations which were mentioned by the teachers were charts, models, outlets for portable fume hoods, and overhead ventilators above the demonstration desk.

The biology teachers' evaluations of their demonstration equipment are shown in Fig. 7. About 80 per cent of the teachers felt that their demonstration equipment was adequate or outstanding. The teachers at the largest schools were least satisfied; 30 per cent of them reported inadequate demonstration equipment. Those teachers dissatisfied with the demonstration facilities and equipment provided remarked that there were no provisions for demonstrations, that the equipment was old or inadequate, that the utilities were not properly provided, and that it was difficult for some students to see the demonstrations due to the arrangement of the classroom.

Audio-visual equipment. Table X presents data concerning audio-visual equipment and facilities available to general biology students in the schools studied. About 64 per cent of the schools reported darkening provisions within the room itself, while in 22.8 per cent of the schools it was necessary to move to another room to use certain audio-visual equipment. Projection screens were found in 94.6 per cent of the schools; 97.8 per cent of the schools reported motion picture projectors available to biology classes; 95.7 per cent reported that slide-filmstrip projectors were available; and 70.6 per cent of the schools indicated that microprojectors were present for use in biology. From this information these schools appeared to meet General Criterion Eight satisfactorily.

FIGURE 7

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE DEMONSTRATION EQUIPMENT
AVAILABLE TO THEM

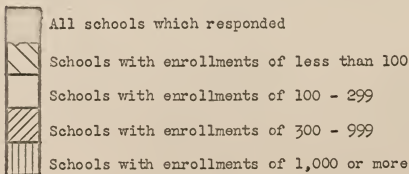
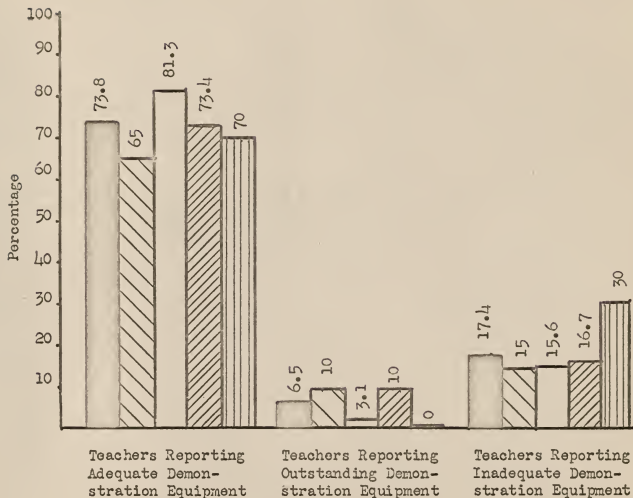


TABLE X

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS REPORTING
VARIOUS TYPES OF AUDIO-VISUAL EQUIPMENT
AND FACILITIES

Enrollment	Number of Respon- dents	Provisions Reported							
		Motion Picture Projector	Room May be Darkened	Another Room*	Screen	Slide- Filmstrip Projector	Micro- Projector	Overhead Projector	
		No. %	No. %	No. %	No. %	No. %	No. %	No. %	
Less than 100	20	20 100	12 60	7 35	20 100	19 95	13 65	2 10	
100 - 299	32	32 100	21 65.6	7 21.8	30 93.7	30 93.7	19 59.4	9 28.1	
300 - 999	30	28 93.4	16 53.4	7 23.3	27 90	29 96.7	23 76.7	7 23.3	
1,000 or more	10	10 100	10 100	0 0	10 100	10 100	10 100	5 50	
Total	92	90 97.8	59 64.2	21 22.8	87 94.6	88 95.7	65 70.6	23 25	

*schools in which it was necessary to go to another room to view slides, films, etc.

TABLE X (continued)

Enrollment	Number of Respon- dents	Provisions Reported					
		Overhead Projector No. %	Opaque Projector No. %	Tape Recorder No. %	Radio No. %	Television No. %	Other No. %
Less than 100	20	2 10	7 35	10 50	5 25	0 0	0 0
100 - 299	32	9 28.1	18 56.3	14 43.8	9 28.1	5 15.6	2 6.3
300 - 999	30	7 23.3	17 56.7	14 46.7	4 13.3	2 6.7	2 6.7
1,000 or more	10	5 50	6 60	6 60	3 30	1 10	0 0
Total	92	23 25	48 52.2	44 47.8	21 22.8	8 8.7	4 4.4

Other audio-visual equipment reported by the schools included opaque projectors (52.2% of the schools), overhead projectors (25%), tape recorders (47.8%), radios (22.8%), and television (8.7%).

Fig. 8 shows the teachers' evaluations of the audio-visual equipment available to biology classes. Almost 74 per cent of the teachers felt that they had adequate or excellent audio-visual equipment and facilities. About 23 per cent felt that the provisions were inadequate.

Laboratory equipment and tools. Table XI presents information concerning the student laboratory equipment present in the biology rooms studied. Student microscopes were reported by 94.6 per cent of the schools; this indicates that these schools met General Criterion Eight with respect to microscopes. Adequate glassware was reported by 81.5 per cent of the schools and adequate general equipment was reported by 80.4 per cent of them. Other laboratory equipment reported included microtones, a centrifuge, slide warmer, incubator, and prepared slides. A kymograph and stereozoom microscopes were also reported.

The teachers' evaluations of the student laboratory equipment available to them are shown in Fig. 9. About 69 per cent felt that the available equipment was adequate or excellent. Nearly 30 per cent reported inadequate student laboratory equipment. Teachers who felt that their laboratory equipment was inadequate frequently remarked that they did not have enough equipment or that the equipment was old and needed to be repaired or replaced. Although most of the schools reported having student microscopes, several teachers noted that there were not enough of them for effective laboratory work.

FIGURE 8

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS OF THE
AUDIO-VISUAL ARRANGEMENTS AND EQUIPMENT
AVAILABLE TO THEM

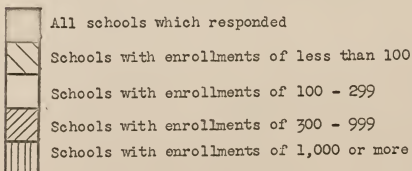


TABLE XI

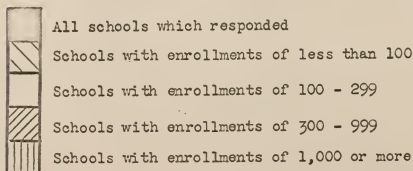
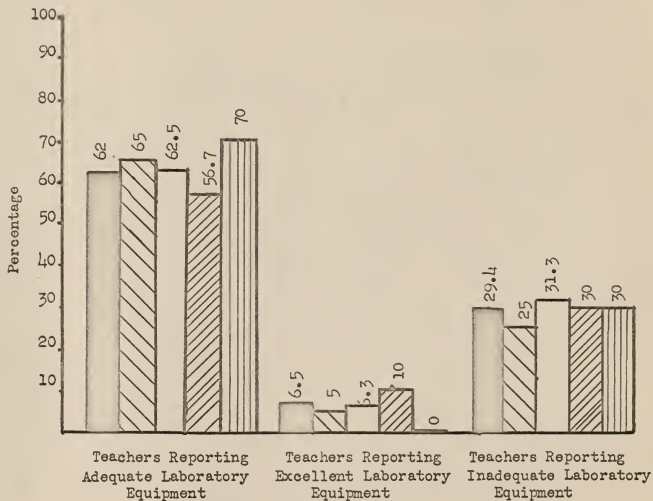
NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS REPORTING
ADEQUATE STUDENT LABORATORY EQUIPMENT FOR GENERAL BIOLOGY

Enrollment	Number of Respon- dents	Laboratory Equipment Reported					
		Student Microscopes		Adequate Glassware		Adequate General Equipment*	
		No.	%	No.	%	No.	%
Less than 100	20	18	90	18	90	19	95
100 - 299	32	30	93.7	25	78.1	26	81.2
300 - 999	30	29	96.7	23	76.7	21	70
1,000 or more	10	10	100	9	90	8	80
Total	92	87	94.6	75	81.5	74	80.4
						2	2.2

*ringstands, clamps, etc.

FIGURE 9

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE STUDENT LABORATORY EQUIPMENT
AVAILABLE TO THEM



General equipment available to biology teachers is shown in Table XII. A good set of tools for working with wood or metal was reported by 35.9 per cent of the teachers. About 28 per cent reported inadequate tool supplies. With respect to an adequate supply of tools, then, these schools failed to meet General Criterion Nine.

Improvised equipment was reported to be frequently used by 31.6 per cent of the schools. This appears to indicate that improvised equipment, although used somewhat, was not employed extensively in most of the schools studied. With regard to improvised equipment, these schools met General Criterion Nine.

Only 5.4 per cent of the schools reported the presence of much broken equipment which would be useful if repaired.

Provisions for living things. Table XIII shows the provisions for living things which were reported by the schools studied. Living plants and animals were found to be present in 67.4 per cent of the biology rooms. About 58 per cent of the schools had portable aquaria, while 44.5 per cent were equipped with stationary aquaria. With respect to aquaria, these schools appeared to have met General Criterion Ten. Animal cages were reported by 49 per cent of the schools; 42.4 per cent had terraria available. Germinating beds were reported by 22.8 per cent of the schools. With regard to animal cages, terraria, and germinating beds, these schools failed to meet General Criterion Ten.

Animal rooms were reported by 9.8 per cent of the schools; 16.3 per cent had plant growing rooms. Separate greenhouses were available to 8.7 per cent of the biology rooms, and 2.2 per cent of the schools

TABLE XII

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS
REPORTING VARIOUS GENERAL EQUIPMENT PROVISIONS
FOR GENERAL BIOLOGY CLASSES

Enrollment	Number of Respon- dents	Provisions Reported									
		Improvised Equipment Often Used	Good Set of Tools Available*	Tools Available; Not Enough		Broken Equipment**	Other				
				No.	%			No.	%		
Less than 100	20	5	25	11	55	3	15	1	5	0	0
100 - 299	32	12	37.5	11	34.4	11	34.4	3	9.4	1	3.1
300 - 999	30	8	26.6	7	23.3	9	30	1	3.3	1	3.3
1,000 or more	10	4	40	4	40	3	30	0	0	1	10
Total	92	29	31.1	33	35.9	26	28.2	5	5.4	3	3.3

* for use in working with wood and metal

**This item on the questionnaire stated, "Much broken equipment is present, which could be used if repaired."

TABLE XIII
NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS REPORTING
VARIOUS PROVISIONS FOR LIVING THINGS AVAILABLE TO
GENERAL BIOLOGY CLASSES

Enrollment	Number of Respon- dents	Provisions Reported							
		Living Plants and Animals	Portable Aquarium	Station- ary Aquarium	Animal Cages	Terrarium	Germinating Bed	Animal Room	
		No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %
Less than 100	20	9 45	10 50	4 20	4 20	4 20	2 10	0 0	
100 - 299	32	20 62.5	19 59.4	11 34.4	12 37.5	10 31.3	8 25	2 6.3	
300 - 999	30	23 76.7	18 60	18 60	19 63.4	16 53.4	11 36.6	4 13.3	
1,000 or more	10	10 100	6 60	8 80	10 100	9 90	0 0	3 30	
Total	92	62 67.4	53 57.6	41 44.5	45 49	39 42.4	21 22.8	9 9.8	

TABLE XIII (continued)

Enrollment	Number of Respon- dents	Provisions Reported					
		Plant Growing Room	Separate Greenhouse	Garden Plot	Nature Trail		
		No. %	No. %	No. %	No. %		
Less than 100	20	2 10	0 0	1 5	1 5		
100 - 299	32	3 9.4	2 6.3	1 3.1	2 6.3		
300 - 999	30	6 20	3 10	0 0	2 6.7		
1,000 or more	10	4 40	3 30	0 0	2 20		

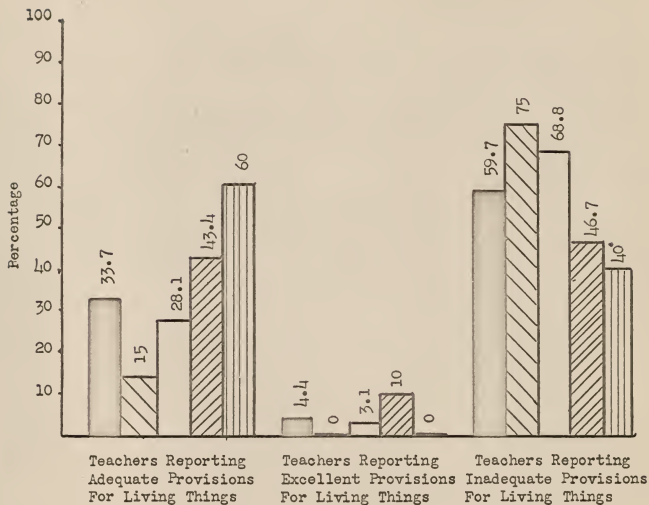
reported that a garden plot was available. Almost 8 per cent of the schools had nature trails. With the exception of portable aquaria, garden plots, and germinating beds, there was a very noticeable increase in the availability of provisions for living things as school size increased.

Evaluations by the teachers of the provisions for living things available to them are shown in Fig. 10. Only about 38 per cent of the teachers felt that they had adequate or excellent provisions for living things. Nearly 60 per cent felt that the provisions were inadequate. There was a pronounced tendency for the teachers in the larger schools to report more nearly adequate equipment than did those from smaller schools; however, of teachers of the largest schools, 40 per cent reported inadequate provisions for living things. The comment most commonly received from teachers who felt that their provisions for living things were inadequate was that there were no provisions for living things in the biology room or that fish alone were provided for.

Provisions for safety. Safety provisions reported by the high schools surveyed are recorded in Table XIV. First aid kits within the biology room were reported by 58.7 per cent of the schools. About 64 per cent were found to have fire extinguishers within the classroom and 38 per cent had fire extinguishers or hoses in nearby halls. With respect to these two provisions for safety, these schools apparently met General Criterion Eleven reasonably well; however with respect to the possession of a laboratory emergency chart they failed, since only 27.2 per cent of the schools had such charts in the biology room. Fire blankets were reported in 9.8 per cent of the rooms. Students were instructed in safe

FIGURE 10

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE PROVISIONS FOR LIVING THINGS
AVAILABLE TO THEM



All schools which responded

Schools with enrollments of less than 100

Schools with enrollments of 100 - 299

Schools with enrollments of 300 - 999

Schools with enrollments of more than 1,000

TABLE XIV

NUMBERS AND PERCENTAGES OF KANSAS PUBLIC HIGH SCHOOLS
REPORTING VARIOUS SAFETY PROVISIONS
FOR GENERAL BIOLOGY CLASSES

Enrollment	Number of Respon- dents	Safety Provisions Reported									
		First Aid Kit in Room	Fire Extinguisher in Room	Fire Extinguisher or Hose in Hall	Fire Blanket	Laboratory First Aid Chart	Safety Instructor *	Use of Fire Extinguisher Taught	Basic First Aid Taught		
		No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %		
Less than 100	20	14 70	15 75	8 40	2 10	7 35	14 70	11 55	14 70		
100 - 299	32	21 65.6	26 81.2	9 28.1	4 12.5	14 43.8	27 84.4	19 59.4	22 68.8		
300 - 999	30	15 50	14 46.7	13 43.4	3 10	3 10	16 53.4	2 6.7	12 40		
1,000 or more	10	4 40	4 40	5 50	0 0	1 10	7 70	2 20	5 50		
Total	92	54 58.7	59 64.2	35 38	9 9.8	25 27.2	64 69.6	34 37	53 57.6		

^{*}students carefully instructed in safe laboratory procedures.

laboratory procedures in 69.6 per cent of the schools; 37 per cent of the teachers taught the students to use fire extinguishers; and 57.6 per cent taught their students basic first aid principles. One teacher reported that the students were trained to check each other on procedures used in laboratory.

First aid kits and fire extinguishers within the biology room were found more frequently in the smaller schools than in the larger ones. The use of the fire extinguisher and basic first aid principles were taught more frequently in the smaller schools than in the larger ones, according to these data.

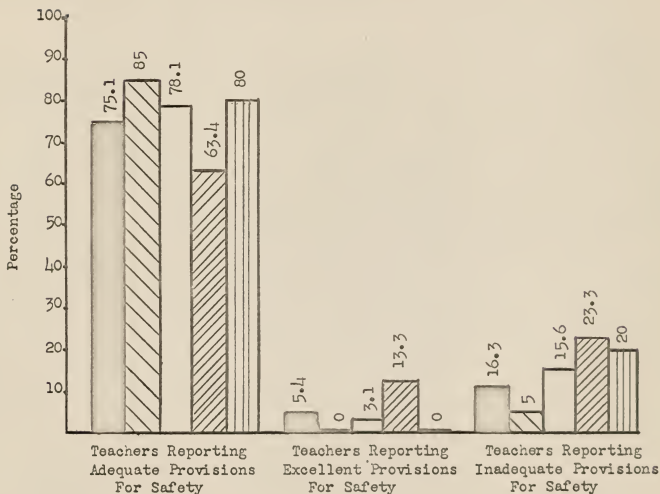
Fig. 11 shows the teachers' evaluations of the safety provisions available to them. About 80 per cent felt that their provisions for safety were adequate or excellent. Inadequate provisions were reported by 16.3 per cent of them.

Class load and adequacy of the facilities. The average class loads for the biology rooms studied are given in Table XV. Of the smallest schools, 25 per cent had average class sizes of from ten to fourteen, and 35 per cent had class sizes of from fifteen to nineteen. The largest number of schools with enrollments of 100 - 299 had class loads of from twenty to twenty-nine. Of the schools with enrollments of 300 - 999, 53.4 per cent reported class loads of from twenty-five to twenty nine students. Fifty per cent of the largest schools reported class loads of from thirty to thirty-four.

The evaluations by the teachers of the adequacy of the rooms and facilities they used, as shown in Fig. 12, reflected this variance in

FIGURE 11

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS OF THE
SAFETY PRECAUTIONS AND EQUIPMENT USED IN
THEIR CLASSROOMS AND LABORATORIES



All schools which responded

Schools with enrollments of less than 100

Schools with enrollments of 100 - 299

Schools with enrollments of 300 - 999

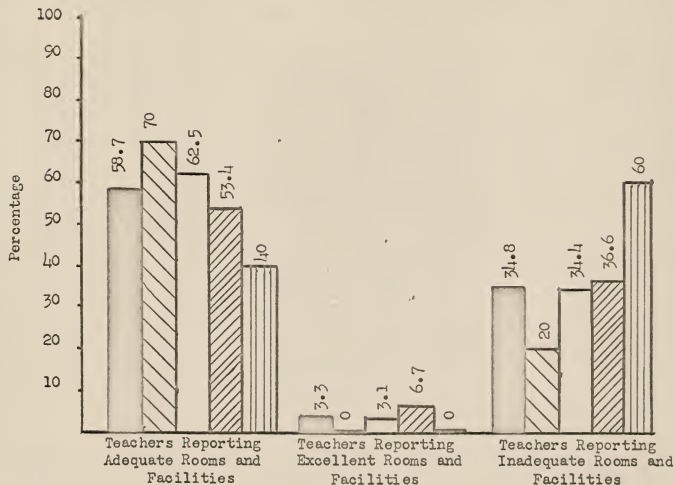
Schools with enrollments of 1,000 or more

TABLE XV
AVERAGE CLASS LOAD REPORTED BY GENERAL BIOLOGY TEACHERS
IN KANSAS PUBLIC HIGH SCHOOLS

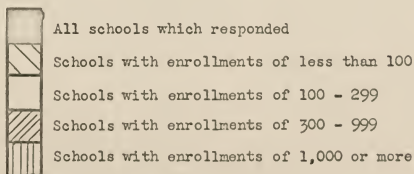
Enrollment	Number of Respon- dents	Class Loads Reported (Number of Students Per Class)									
		Less Than 10	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 or More			
		No. %	No. %	No. %	No. %	No. %	No. %	No. %			
Less than 100	20	4 20	5 25	7 35	3 15	1 5	0 0	0 0			
100 - 299	32	0 0	4 12.5	4 12.5	11 34.4	11 34.4	2 6.3	0 0			
300 - 999	30	0 0	0 0	0 0	8 26.6	16 53.4	5 16.6	1 3.3			
1,000 or more	10	0 0	0 0	0 0	2 20	2 20	5 50	1 10			
Total	92	4 4.4	9 9.8	11 11.9	24 26.2	30 32.6	12 13	2 2.2			

FIGURE 12

EVALUATION BY KANSAS GENERAL BIOLOGY TEACHERS
OF THE ADEQUACY OF THE ROOMS AND
FACILITIES WHICH THEY USED*



*Teachers were asked to indicate whether or not their rooms and facilities were adequate for the number of students using them.



class load as the school became larger. The teachers from the smallest schools reported that their facilities were adequate more frequently than did those from the largest schools. As a whole, about 62 per cent of the teachers reported facilities and rooms adequate for the number of students using them, and nearly 35 per cent felt that the rooms and facilities were inadequate. Several teachers who reported inadequate provisions for teaching general biology indicated that they would soon be moving into new, adequate facilities. Others stated that attempts had been made to obtain larger facilities, but that they had failed.

SUMMARY AND CONCLUSIONS

It was the purpose of this study (1) to compare the general biology facilities and equipment in public high schools of Kansas with established criteria; (2) to compare the facilities and equipment available for general biology in schools of different sizes; and (3) to discover the teachers' opinions of the adequacy of the facilities and equipment studied.

Criteria were developed through a study of selected literature, based on the frequency with which certain provisions were mentioned by the authorities consulted, the desirability of the provisions as emphasized by the authorities, and the feasibility of such provisions in the State of Kansas as seen by the writer of this report.

The data employed in the study were obtained by means of a questionnaire based on the criteria established and sent to one hundred Kansas public high schools. The questionnaires, completed by biology teachers, were

placed in four groups according to school size, and the data analyzed. For every response to the questionnaire, the number and percentage of the teachers giving the response were recorded, both for each school size group and for the schools as a whole.

The results of the study are summarized in Table XVI. Each item discussed in the criteria was evaluated in terms of the criterion measure established and placed in one of three categories, depending upon the percentage of schools reporting the specified facility, equipment, or condition:

Less than 40 per cent--inadequate

40 to 55 per cent--acceptable

55 per cent or more--adequate.

The biology rooms were found to be acceptable with respect to location as a whole. Several of the rooms were located near other science rooms and some were located near a library. Only a few of the rooms were near shops or home economics rooms. A majority of the biology rooms had easy access to the out-of-doors, and a large number had southern and/or eastern exposures. About three-fourths of the teachers using these rooms felt that the locations were adequate or excellent.

The schools compared quite favorably with the criterion measures regarding classroom and laboratory arrangements. Many schools were using combination classroom-laboratory arrangements for general biology, and most of the biology rooms were built or furnished as science rooms. With respect to student furniture, however, the schools did not meet the standards set. Usually the furniture reported consisted of laboratory tables

TABLE XVI

A SUMMARY: EVALUATIONS OF THE BIOLOGY ROOMS STUDIED
IN TERMS OF THE CRITERIA EMPLOYED

Criteria	Evaluation		
	0	*	**
General Criterion One: Location			
1. Near other science rooms		x	
2. Near shops	x		
3. Near home economics rooms	x		
4. Near library		x	
5. Easy access to out-of-doors			x
6. South and/or east exposure			x
General Criterion Two: Classroom and Lab Arrangement and Furniture			
1. Combination classroom-lab			x
2. Rooms built for science			x
3. Island or perimeter furniture arrangement	x		
General Criterion Three: Storage Facilities			
1. Some locked storage			x
2. Safe storage for dangerous chemicals	x		

⁰Reported by less than 40% of the schools; inadequate.

*Reported by 40% to 55% of the schools; acceptable.

**Reported by 55% or more of the schools; adequate.

TABLE XVI (continued)

Criteria	Evaluation		
	0	*	**
3. Dust-proof storage for optical equipment		x	
4. Refrigerator	x		
General Criterion Four: Display			
1. Glassed-in display in classroom		x	
2. Display facilities lock	x		
3. Adequate tackboard and chalk-board space			x
General Criterion Five: Special Areas			
1. Preparation area			x
2. Long-term project area	x		
3. Conference area or office	x		
General Criterion Six: Utilities			
1. Electrical outlets			
a. conveniently located			x
b. at each work station		x	
2. Natural or liquefied gas			x
3. Hot and cold running water			x
General Criterion Seven: Demonstration Equipment			
1. Demonstration desk			x
2. Gas, water, electricity available at demonstration desk			x
3. Special lighting for demonstrations	x		

TABLE XVI (continued)

Criteria	Evaluation		
	0	*	**
General Criterion Eight: Audio-Visual Equipment			
1. Darkening provisions within the biology room			x
2. Screen, motion picture projector, slide-filmstrip projector, micro-projector			x
3. Student microscopes			x
General Criterion Nine: Tools, Equipment			
1. Good set of tools for use with metal or wood	x		
2. Some improvised equipment used, but not exclusively			x
General Criterion Ten: Living Things			
1. Aquarium			x
2. Germinating bed	x		
3. Animal cages		x	
4. Terrarium		x	
General Criterion Eleven: Safety			
1. First aid kit in room			x
2. Laboratory first aid chart	x		
3. Fire extinguisher or hose in room or nearby hall			x

in rows rather than the recommended perimeter or island arrangements. Slightly less than half of the schools reported that the students sat at the laboratory desks during classroom activities. The smaller schools appeared to use perimeter laboratory work areas to a greater extent than did the larger ones. Over half of the teachers were satisfied with their classroom and laboratory arrangements, while more than one-third were not. Teachers in the smallest schools appeared more satisfied with the furniture arrangements than did those in the largest schools.

The storage facilities studied were found to be adequate in that most schools had some storage space which could be locked. Few biology classrooms were equipped with special storage facilities for dangerous chemicals or with refrigerators, however. A fair number of the rooms were provided with dustproof storage facilities for optical equipment. Drawers were the most frequently mentioned type of storage facility, and glassed-in shelves and cupboards were frequently mentioned. Open shelves were used least often and were found most frequently in the smallest schools. About one-third of the schools provided individual storage for students, and nearly two-thirds supplied storage facilities for the teacher's use. Most of the teachers were satisfied with the available storage facilities, particularly those in the smallest schools.

The display facilities as a whole were found to be acceptable. Most schools had adequate tackboard and chalkboard space, but very few were equipped with glassed-in display cases in the classroom. About one-half of the schools reported having locked display cases. Generally, more display facilities were reported by the largest schools. Half of

the teachers questioned felt that their display provisions were inadequate.

The only special area present in most of the schools was a preparation area. Few schools had space for long-term projects or a teacher's office or conference area. Less than one-fourth of the schools reported having areas for maintenance and repair of equipment.

Generally, the utilities provided were adequate; however, only between 30 and 40 per cent of the schools were equipped with gas, water, and electricity at student work stations. About three-fourths of the teachers were satisfied with the available utilities.

The schools reported adequate provisions for demonstrations in that most of them had demonstration desks available which were equipped with gas, water, and electricity; however almost none of the facilities were provided with special lighting for the demonstrations. About 80 per cent of all the teachers were satisfied with their demonstration equipment.

The schools studied were found to be adequate with respect to the three criterion measures used. About 64 per cent of the teachers indicated that the biology rooms could be darkened, and almost all of them reported that projection screens, motion picture projectors, and slide-filmstrip projectors were available. Approximately 70 per cent of the biology rooms had microprojectors available. Although nearly all rooms were equipped with student microscopes, many teachers felt that the number of microscopes was inadequate. Nearly three-fourths of the teachers considered their audio-visual provisions adequate.

Approximately 80 per cent of the teachers reported adequate labora-

tory glassware and general laboratory equipment. About 70 per cent felt that the student laboratory equipment as a whole was adequate. Provisions for tools in the biology rooms were inadequate. Improvised equipment was found to be used frequently by only about one-third of the schools. Thus, the schools as a whole were found to be adequate with respect to the use of improvised equipment, since such equipment was used to some extent but not exclusively.

The biology provisions studied were rated acceptable according to the criterion measures used. Provisions for aquaria were adequate; those for animal cages and terraria were acceptable; and germinating bed provisions were inadequate. Several schools, particularly the smaller ones, reported that no provisions for living things were present. Better provisions for plants and animals were generally found in the larger schools. Nearly 60 per cent of the teachers rated their equipment and facilities for living things inadequate.

The rooms were found to be adequately equipped for safety, in that most of them were provided with first aid kits and fire extinguishers or hoses; however they were inadequate with respect to laboratory first aid charts, which were available in less than one-third of the rooms. The smaller schools were found to give more instruction to the students regarding safety in the classroom and laboratory, and they seemed better equipped for emergencies than did the larger schools.

The number of students per biology class was found to increase with the size of the school. Teachers in the smallest schools reported that their facilities and equipment were adequate for the number of stu-

dents using them more frequently than did teachers from the largest schools. About 62 per cent of the teachers felt that their rooms were adequate for the number of students using them.

From the information presented, it was concluded that the schools as a whole met one-half of the thirty-eight criterion measures adequately. They were inadequate with respect to twelve (nearly one-third) of them. The schools as a whole were best equipped with (1) audio-visual aids, (2) demonstration facilities, and (3) utilities. They were most poorly supplied with provisions for (1) display, (2) living things, and (3) storage.

When the facilities and equipment were compared as to school enrollment size, it was concluded that:

1. The smaller schools had more flexible furniture arrangements and were better equipped for classroom safety than were the larger schools.
2. The larger schools were better provided with provisions for display and for living things.
3. Inadequate facilities due to heavy class loads were more common in the larger schools.

From the evaluative data supplied by the teachers, it was concluded that, as a rule:

1. The teachers were satisfied with the locations of their rooms, the utilities provided, the demonstration and audio-visual provisions, the student laboratory equipment, and the safety provisions.

2. The teachers, except for those in the largest schools, were dissatisfied with the provisions for living things and those for display of materials.
3. The teachers from the largest schools tended to be dissatisfied with the furniture arrangements and to feel that their facilities and equipment were inadequate for the number of students using them.

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APPENDIX A

NUMBER AND ENROLLMENTS OF KANSAS SECONDARY SCHOOLS
INCLUDED AND RESPONDING IN THIS SURVEY

NUMBER AND ENROLLMENTS OF KANSAS SECONDARY SCHOOLS
INCLUDED AND RESPONDING IN THIS SURVEY

Enrollment	Number of Schools Contacted	Number of Schools Responding
Less than 100	25	20
100 - 199	21	21
200 - 299	13	11
300 - 399	10	10
400 - 499	5-	5
500 - 599	5	5
600 - 699	4	4
700 - 999	6	6
1,000 or more	11	10

APPENDIX B

BIOLOGY FACILITIES QUESTIONNAIRE

BIOLOGY FACILITIES QUESTIONNAIRE

Instructions: Below are several statements concerning biology facilities and equipment. Please check each item mentioned which is present in the room(s) you use. Additional information is welcome, though not required. The back of the sheet may be used for this purpose.

I. THE ROOM

A. Location of the Room:

- ☐ 1. In a separate science wing or building.
- ☐ 2. Near other science rooms.
- ☐ 3. Near shops.
- ☐ 4. Near home economics rooms.
- ☐ 5. Near mathematics rooms.
- ☐ 6. Near library.
- ☐ 7. Easy access to out-of-doors (without disturbing other classes)
- ☐ 8. Other:

B. Structural features of the room:

- 1. Exposure of windows (direction in which they face)--
 - ☐ a. north ☐ b. east ☐ c. south ☐ d. west
 - ☐ e. other:
- ☐ 2. Room may be darkened.
- 3. Type of biology room arrangement--
 - ☐ a. combination classroom-laboratory.
 - ☐ b. separate rooms for lecture and for laboratory.
 - ☐ c. classroom not originally designed for science.
 - ☐ d. other:
- 4. Type of storage facilities present--
 - ☐ a. open shelves ☐ b. cupboards
 - ☐ c. glassed-in shelves ☐ d. drawers
 - ☐ e. dust-proof storage for optical equipment ☐ f. special storage for dangerous chemicals
 - ☐ g. some storage facilities which lock
 - ☐ h. individual storage facilities for each student
 - ☐ i. storage space for use by teacher
 - ☐ j. refrigerator
 - ☐ k. other:
- 5. Display areas provided--
 - ☐ a. glassed-in display case within classroom
 - ☐ b. glassed-in display case outside of classroom
 - ☐ c. display cases have locks
 - ☐ d. adequate tackboard space
 - ☐ e. adequate chalkboard space
 - ☐ f. other provisions for display:

6. Special areas provided

- _____ a. area for preparation of laboratory and demonstration materials
- _____ b. area available for maintenance and repair of equipment
- _____ c. area where long-term projects may be left undisturbed.
- _____ d. office or conference area for teacher.
- _____ e. Other special areas present:

C. Utilities provided:

- _____ 1. Natural gas
- _____ 2. Bottled gas
- _____ 3. Fume hood
- _____ 4. Cold running water only
- _____ 5. Hot and cold running water
- _____ 6. AC electrical outlets conveniently located
- _____ 7. AC electrical outlets
- _____ 8. Other utilities provided:

D. Student furniture:

- _____ 1. Laboratory desks located around the perimeter of the room next to walls.
- _____ 2. Island arrangement of laboratory desks.
- _____ 3. Laboratory desks are tables in rows.
- _____ 4. Students sit at laboratory desks during classroom sessions as well as laboratory periods.
- _____ 5. Gas outlets available at student desks.
- _____ 6. Running water available at student desks.
- _____ 7. Electrical outlets available at student desks.
- _____ 8. Other student furniture arrangements:

II. EQUIPMENT

A. Demonstration equipment:

- _____ 1. Fixed demonstration desk.
- _____ 2. Movable demonstration desk or cart.
- _____ 3. Utilities present at demonstration desk--
 - _____ a. running water
 - _____ b. gas outlet
 - _____ c. electrical outlet
 - _____ d. other:
- _____ 4. Spotlighting arrangement over demonstration desk.
- _____ 5. Other demonstration equipment:

B. Audio-visual equipment:

- 1. Equipment available for use in biology:
 - _____ a. motion picture projector
 - _____ b. opaque projector
 - _____ c. filmstrip-slide projector
 - _____ d. overhead projector
 - _____ e. screen
 - _____ f. microprojector
 - _____ g. tape recorder
 - _____ h. radio
 - _____ i. television
 - _____ j. other audio-visual equipment:
- _____ 2. It is necessary to go to another room to view slides, films.
- _____ 3. Other arrangements for audio-visual aids:

C. Student laboratory equipment:

- ☐ 1. Microscopes for student use.
- ☐ 2. Adequate supply of glassware.
- ☐ 3. Adequate supply of general equipment (ringstands, clamps, etc.)
- ☐ 4. Other information about laboratory equipment:

D. General equipment:

- ☐ 1. Improvised equipment frequently used.
- ☐ 2. A good set of tools for working with wood and metal equipment is available.
- ☐ 3. Some tools are available, but not enough for good maintenance and repair of equipment.
- ☐ 4. Much broken equipment is present, which could be used if repaired.
- ☐ 5. Other information about general equipment:

III. PROVISIONS FOR LIVING THINGS

- ☐ 1. Living plants and animals present in room.
- ☐ 2. Portable aquarium present.
- ☐ 3. Stationary aquarium.
- ☐ 4. Terrarium.
- ☐ 5. Animal room.
- ☐ 6. Plant growing room.
- ☐ 7. Separate greenhouse.
- ☐ 8. Garden plot
- ☐ 9. Germinating bed.
- ☐ 10. Animal cages.
- ☐ 11. Nature trail.
- ☐ 12. Other provisions for care and study of living things:

IV. PROVISIONS FOR SAFETY

- ☐ 1. First aid kit in room.
- ☐ 2. Fire extinguisher in room.
- ☐ 3. Fire extinguisher or hose in nearby hall (if not in room).
- ☐ 4. Fire blanket.
- ☐ 5. Laboratory first aid chart in room.
- ☐ 6. Students carefully instructed in safe laboratory procedures.
- ☐ 7. Students shown how to use fire extinguisher.
- ☐ 8. Students instructed in basic first-aid principles.
- ☐ 9. Other safety measures:

V. CLASS LOAD: In this section, please answer the questions in the spaces provided.

- 1. In what grade are most of the students in your general biology classes?

-
- 2. How many general biology classes meet in this room? _____

3. What classes other than general biology meet in this room? _____

4. If there are other classes using the room, is the room equipped to handle them? _____

5. What is the average number of students in a general biology class in this room? _____

6. Other information about class load; _____

VI. TEACHER EVALUATION: This section is intended to be an evaluation by you, the teacher, of how well the room and its facilities meet the needs of your own way of teaching and live up to your expectations of adequacy.

Below are several evaluative statements regarding facilities and equipment. If you feel that the statement is true in regard to your room, please check in the column marked "yes". If you do not feel that the statement is true, check in the "no" column. If you feel that the item discussed is exceptionally well provided for, check in the "E" column.

E	Yes	No	
			1. The location of the science room is satisfactory.
			2. The classroom and laboratory arrangement is satisfactory.
			3. The storage facilities provide safe, adequate, and orderly storage of materials.
			4. The display space is adequate.
			5. The utilities present are adequate and convenient.
			6. The furniture arrangement is conducive to orderly, uncongested laboratory work.
			7. This room and its facilities are adequate for the number of students using them.
			8. The demonstration equipment is adequate and effective.
			9. The audio-visual equipment and arrangements are satisfactory.
			10. The available student laboratory equipment is adequate.
			11. The provisions for living things are adequate for a general biology course.
			12. The safety precautions and equipment are satisfactory.

If you checked any of the above items "no", it would be greatly appreciated if you would state below and on the back of this sheet any recommendations you have regarding these facilities and their improvement. Any other comments you may have are welcome.

APPENDIX C

LETTER ACCOMPANYING THE QUESTIONNAIRES

927 Moro Street
Manhattan, Kansas
April 5, 1963

Dear School Administrator:

Enclosed you will find a four-page questionnaire dealing with the general biology facilities and equipment in your school. This Questionnaire forms the basis of research which I am doing in partial fulfillment of the Master of Science degree in secondary education at Kansas State University, and I would greatly appreciate your help.

As everyone in education is well aware, science education has received increasing attention during the past few years; consequently, many studies have been carried out and recommendations made as to the kind and amount of facilities and equipment which are adequate for good science instruction. It is the purpose of this study to survey the general biology facilities of a number of Kansas high schools and to compare the data from this survey with some of the criteria which have been established.

The questionnaire is designed to be completed by a teacher of general (first-year) high school biology, and concerns the room in which this teacher works. If there is more than one biology room in your school, please give the form to one of the teachers to complete, preferably the one who teaches the largest number of general biology classes. All information obtained on the questionnaire is confidential, and the names and locations of individual schools will not appear in the report.

When the form is completed, please have it returned in the enclosed stamped envelope by April 30, if at all possible.

Thank you and your biology teacher for your assistance in this research.

Respectfully yours,

(Mrs.) Sheila J. Cunningham

APPENDIX D
FOLLOW-UP LETTER

927 Moro Street
Manhattan, Kansas
May 2, 1963

Dear School Administrator:

Early last month a questionnaire regarding your high school's general biology facilities was mailed to you. Your school was one of one hundred randomly-selected schools in Kansas consulted in this study. The response to this request has been fairly good; over seventy schools have returned the forms. In order to obtain a truly representative picture of the status of Kansas high school biology facilities, however, a much better response is needed.

Since the April 30 deadline for returning the questionnaires is now past and the form sent to you has not been received, I would like to urge you to have the form filled out and returned if you have not already done so.

Enclosed is a copy of the questionnaire, along with a stamped envelope. Please have a teacher of general (first-year) high school biology complete the form, using information about the room in which this teacher works. The completed questionnaire may then be returned in the envelope. If your school is not offering general biology, please indicate this in the space provided on the questionnaire and return it. This information, too, will be helpful.

As was stated in the earlier letter, this information is for use in a Masters report at Kansas State University and will remain confidential. Thank you for your assistance in this research.

Respectfully yours,

(Mrs.) Sheila J. Cunningham

A STUDY OF FACILITIES AND EQUIPMENT AVAILABLE TO
GENERAL BIOLOGY TEACHERS IN SELECTED PUBLIC
SENIOR HIGH SCHOOLS OF KANSAS

by

SHEILA JOY CUNNINGHAM

B. A., Kansas State University, 1961

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree


MASTER OF SCIENCE

School of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1963

Approved by:



Major Professor

The purpose of this study was to compare the facilities and equipment available in general biology rooms of Kansas public high schools with certain criteria for general biology classrooms and laboratories.

The criteria employed in this research were developed from a survey of the literature and selected on the following bases:

- (1) frequency of mention
- (2) desirability as emphasized in the selected literature
- (3) feasibility of application to the State of Kansas as discerned by the writer.

Information about existing Kansas general biology facilities was obtained by means of a questionnaire which was based on literature studied and on the criteria developed. The questionnaire was sent to one hundred selected Kansas public senior high schools. The schools were divided into four groups with enrollments of (1) less than 100, (2) 100 - 299, (3) 300 - 999, and (4) 1,000 or more. Information obtained from the 92 questionnaires returned was analyzed by enrollment size group and totals for the schools as a whole were calculated. The information obtained was compared with the established criteria; several other provisions for biology were surveyed. The facilities and equipment available to the schools of the four different size groups were compared. Teachers' evaluations of available facilities and equipment were obtained.

A comparison of the responses to the questionnaires with the criteria indicated that the rooms had fair or poor locations; however, a large percentage of the schools reported biology rooms located with easy

access to the out-of-doors and with windows facing to either the south or east. In these two respects, the rooms were satisfactorily situated. About 83 per cent of the teachers questioned felt that their rooms were well located.

The arrangements of the classrooms and laboratories followed the recent trend toward combination classroom-laboratory facilities; most of the biology classes were using rooms built for science. The furniture arrangements reported most frequently did not allow for much flexibility in room use.

The types of storage facilities reported were regarded as fair to inadequate. Teachers in about 68 per cent of the schools found their storage facilities to be adequate. Most of the schools reported adequate tackboards and chalkboards, but other provisions for display failed to meet the criteria. Half of the teachers felt that their display provisions were unsatisfactory. Many schools reported preparation areas for laboratory or demonstration materials, but few indicated that areas for long-term projects were present or that conference areas for the teachers were provided.

The utilities found in the general biology rooms met the criteria satisfactorily. Most schools reported having demonstration desks equipped with gas outlets, electricity, and running water; however, almost none of the rooms were found to provide special lighting for demonstrations. The audio-visual equipment available to general biology classes was sufficient. The student laboratory equipment reported was generally adequate. Good sets of tools were rarely available.

Provisions for the care of living things were generally inadequate; however, most schools reported having an aquarium of some kind. About 60 per cent of the teachers reported inadequate provisions for living things. Safety provisions were found to be fairly good; most schools were equipped with first aid kits and had fire hoses or extinguishers either within the room or in a nearby hall. Laboratory first aid charts, however, were found in only a few rooms.

It was concluded that the schools studied met about one-half of the criteria satisfactorily. The smaller schools appeared to have more flexible furniture arrangements and were better equipped for classroom safety than were the larger schools. Better display facilities and provisions for living things were reported by the larger schools. Inadequate facilities due to excessive class loads were reported most frequently by the larger schools.

Date Due

[illegible]